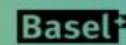


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Metabolic Responses and Fluid and Electrolyte Status Following Badminton Matches: Implications for Player Recovery

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METABOLIC RESPONSES AND FLUID AND ELECTROLYTE STATUS - RELEVANCE



- ❑ Fluid and electrolyte imbalances following matches have due considerations for players recovery fluid homeostasis.
- ❑ Cardiovascular & metabolic responses including heart rate, lactate concentration, glycogen depletion are critically important in understanding the physiological responses to match play.



BACKDROP OF THE STUDY



In badminton tournaments especially at the junior level, players are required to involve in successive matches in a day. This definitely puts high physical and physiological demands on the players, and they may not get enough time for proper recovery to pre levels before subsequent matches.



RESEARCH QUESTIONS



- What metabolic responses are affected from pre game to post match levels following singles matches in badminton?
- How much fluid and electrolyte imbalance occurs from pre game to post match levels following singles matches in badminton?
- What is the pattern of recovery of metabolic responses and fluid and electrolyte levels after singles matches during a recovery period of 30 minutes?



Materials & Methods

- Eight competitive singles players (4 male & 4 female) (Mean \pm SD age: 15 ± 0.85 ; height 165.56 ± 7.26 ; body weight 60.35 ± 6.79) playing at the junior national level circuit in India
- Prior consent was obtained from the coaches and players. Ethical clearance was obtained from the departmental ethics committee.



Study Protocol

- Standard 5-minute match warm-up, followed by best of three singles matches against competitively matched opponent on league basis.
- Stop watches were operated for the entire time of the match and also noted for the rest periods in between.
- The subjects were asked to consume only water during the matches. The amount of water consumed was measured and weighed for estimating the fluid intake during match play.



Materials & Methods

- Blood samples were assessed for plasma glucose, plasma lactate, serum sodium, serum potassium and serum ionized calcium.
- The urine sample were analyzed for urine specific gravity, urine sodium and urine potassium.
- Heart rate was recorded throughout the match using Polar Sport tester (V800)
- Blood samples drawn were analysed for the selected metabolic variables pre match, post match and 30 minutes recovery post match.



Materials & Methods

- Total playing time was registered by the heart rate monitor as well as by video recording of each match, from which the real playing time was estimated.
- The temporal structure was obtained from subsequent analysis of videotaped matches by calculation of work interval or performance time, average rest interval or rest time, and work density (ratio of performance time to rest time).

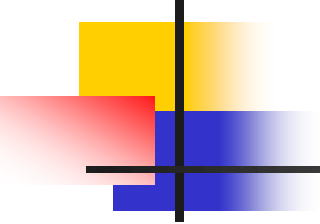
Descriptive Statistics (Mean \pm SD) of Body weight and Metabolic Responses for the Pre, Post and 30 Minutes Recovery of Male Badminton Players

Variables	Pre match	Post match	Recovery (30 mts)
Body weight (kg.)	63.15 \pm 9.46	62.65 \pm 9.23	62.77 \pm 9.89
Heart rate (beats/min)	89.50 \pm 10.78	182.50 \pm 6.45 ^a	115.00 \pm 7.39 ^{b,c}
Plasma glucose (mmol/L)	4.41 \pm 0.44	4.65 \pm 0.37	4.95 \pm 0.14
Plasma lactate (mmol/L)	1.38 \pm 0.37	4.02 \pm 0.46 ^a	2.55 \pm 1.07 ^{b,c}
Serum Na (mmol/L)	139.5 \pm 1.91	138.7 \pm 1.71	138.5 \pm 1.29
Serum K (mEq/L)	4.70 \pm 0.32	4.33 \pm 0.42	4.26 \pm 0.32
Serum Ca (mg/dL)	10.22 \pm 0.57	10.20 \pm 0.69	1.01 \pm 0.53
Urine specific gravity	1.013 \pm 0.0004	1.022 \pm 0.0006	1.015 \pm 0.007
Urine Na (mmol/L)	159.75 \pm 40.97	93.50 \pm 36.70 ^a	98.75 \pm 16.60
Urine K (mmol/L)	88.75 \pm 25.68	57.25 \pm 33.76	95.00 \pm 29.06

Descriptive Statistics (Mean \pm SD) of Body weight and Metabolic Responses for the Pre, Post and 30 Minutes Recovery of Male Badminton Players

Variables	Pre match	Post match	Recovery (30 mts)
Body weight (kg.)	58.12 \pm 3.23	57.17 \pm 3.18	57.85 \pm 3.22
Heart rate (beats/min)	87.25 \pm 8.22	180.50 \pm 9.81 ^a	115.5 \pm 6.35 ^{b,c}
Plasma glucose (mmol/L)	3.99 \pm 0.25	4.26 \pm 0.64	4.47 \pm 0.48
Plasma lactate (mmol/L)	1.43 \pm 0.24	3.50 \pm 0.37 ^a	2.53 \pm 0.31 ^{b,c}
Serum Na (mmol/L)	139.8 \pm 1.26	139.8 \pm 0.96	139.0 \pm 0.82
Serum K (mEq/L)	4.41 \pm 0.18	4.13 \pm 0.21	4.40 \pm 0.23
Serum Ca (mg/dL)	9.63 \pm 0.15	9.57 \pm 0.36	9.40 \pm 0.33
Urine specific gravity	1.017 \pm 0.003	1.018 \pm 0.005	1.018 \pm 0.005
Urine Na (mmol/L)	148.70 \pm 89.76	145.75 \pm 83.82	94.00 \pm 58.56
Urine K (mmol/L)	67.25 \pm 18.99	94.50 \pm 16.54	84.00 \pm 8.75

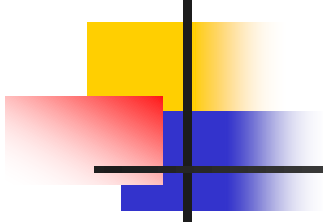
Results and Analysis



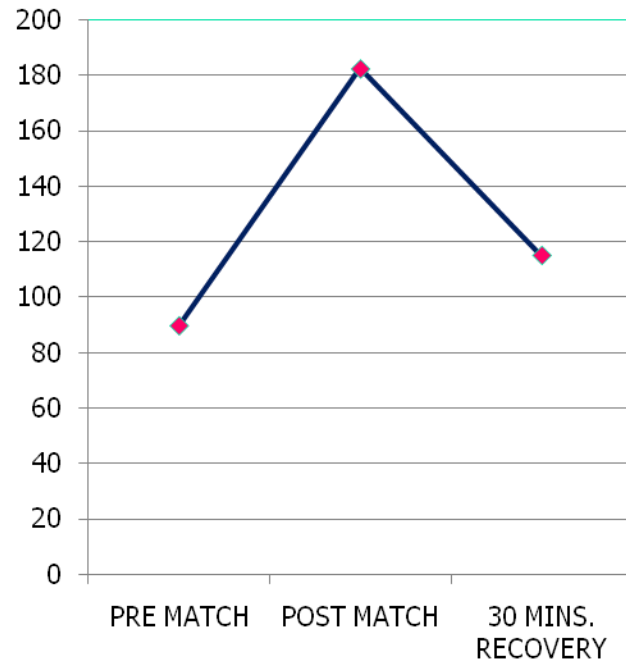
	Male ♂	Female ♀
Average sweat rate	0.99 ± 0.38 l/h	1.23 ± 0.19 l/h
Average fluid intake	0.28 ± 0.10 l/h	0.20 ± 0.09 l/h
Average work time	6.8 ± 0.9 sec.	6.2 ± 1.4 sec.
Average rest time	13.2 ± 2.1 sec.	12.3 ± 3.5 sec.
Work density	0.54 ± 0.05	0.47 ± 0.07

- Average environment temperature $28.06 \pm 1.80^{\circ}\text{C}$
- Average humidity $38.10 \pm 7.20\%$.

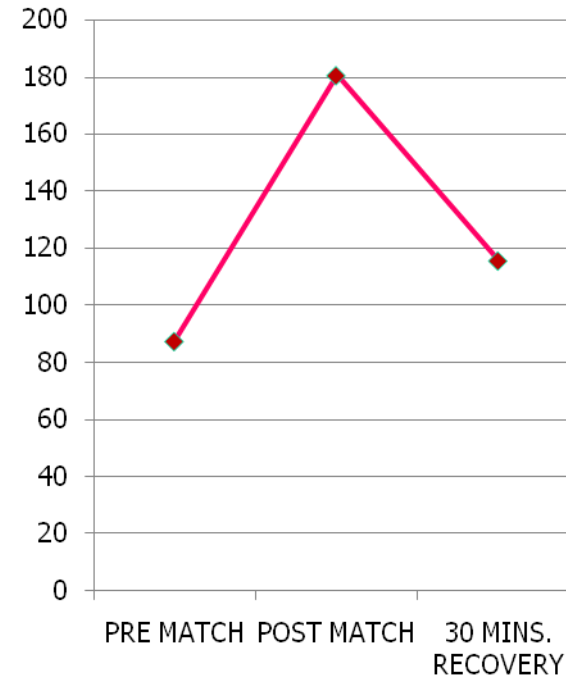
Heart rate responses for pre match, post match and thirty minutes post match recovery among junior players



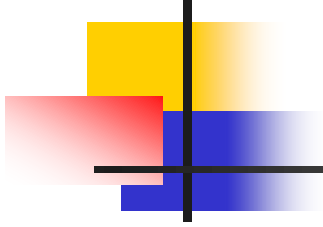
Male



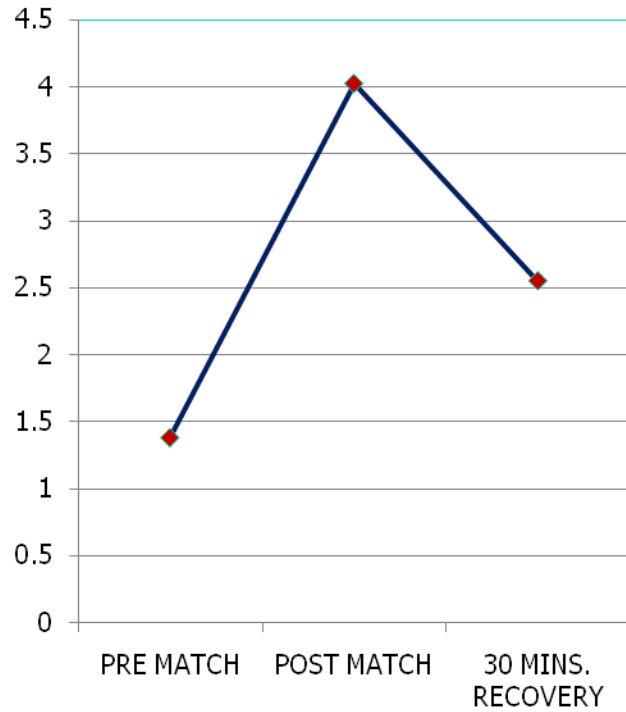
Female



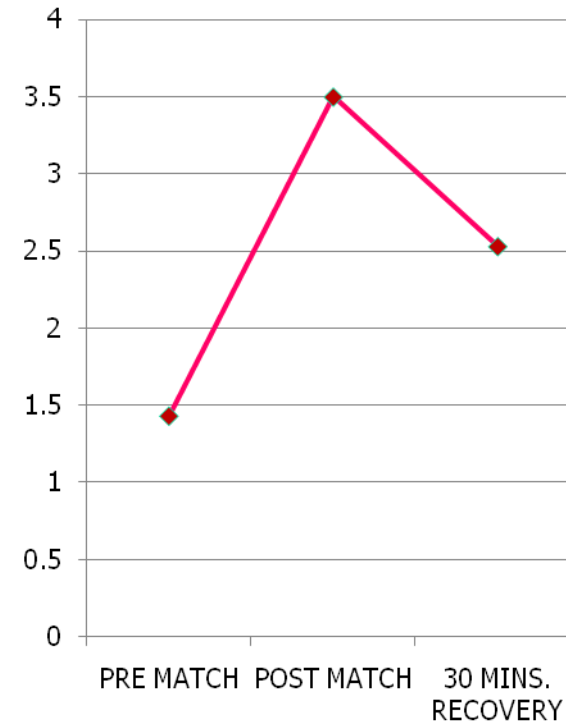
Plasma lactate responses for pre match, post match and thirty minutes post match recovery among junior players



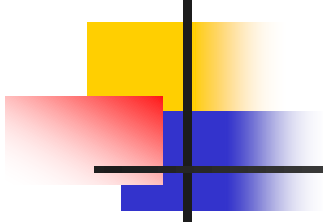
Male



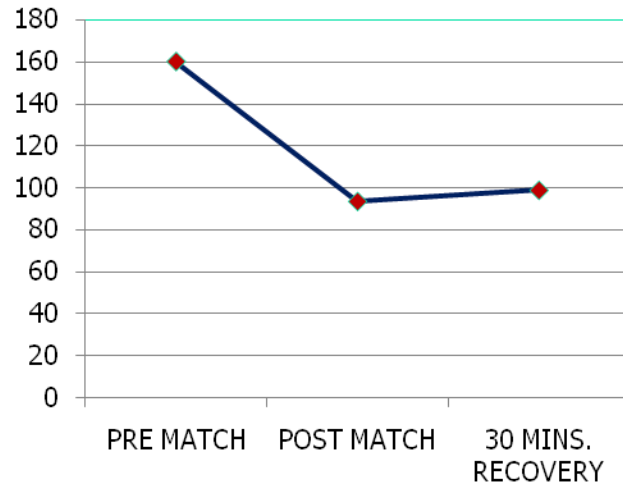
Female



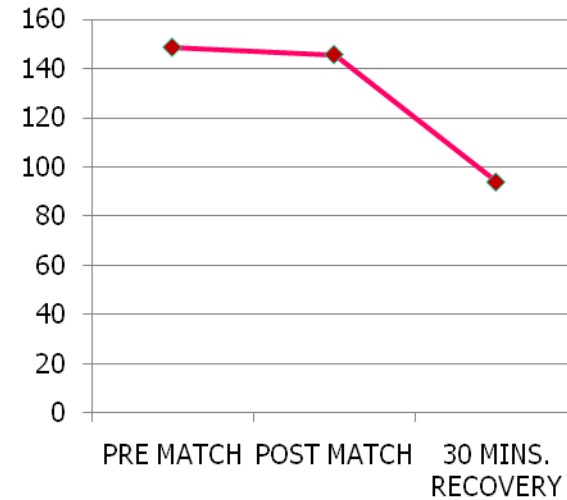
Urine Sodium levels for pre match, post match and thirty minutes post match recovery among junior players



Male



Female





Cardiovascular demands of badminton (junior singles matches)

- Max HR of 204 beats/min
- Max HR of 200 beats/min
- Average HR of 178 beats/min
- Average HR of 172 beats/min





Metabolic demands of badminton (junior singles matches)

- Mean post match lactate 4.02 ± 0.46 mmol/l 
- Mean post match lactate 3.50 ± 0.37 mmol/l 



Temporal characteristics of badminton (junior singles matches)

Variables	Male	Female
Average work time	6.8 seconds	6.2 seconds
Average rest time	13.2 seconds	12.3 seconds
Work Density	0.54 ± 0.05	0.47 ± 0.07
Average duration of match	34.75 ± 6.03 minutes.	30.0 ± 5.91 minutes



Energy demands of badminton

- The intermittent nature & short lasting high intensity efforts interspersed with frequent rest intervals makes badminton game to have predominance in the **alactic energy system**
- The demand on the **phosphagen system** is evident with the temporal characteristics of the game
- However the sustained effort exceeding 30 minutes in singles matches put considerable demand on the **aerobic energy pathway** as well.



Energy demands of badminton

- Range of values for fluid intake, sweat loss and electrolyte loss demonstrates **large variability among the players.**
- The **high variability** in these cardiovascular and metabolic responses following badminton singles matches, and the **lack of recovery to baseline after thirty minutes (HR, Lactate & Urine Na)** may negatively affect performance in subsequent matches.

Conclusions and Recommendations..



- Badminton singles matches present considerable **cardiovascular and metabolic responses**.
- Players need to involve in **active recovery mechanisms** with adequate rest and recovery period to ensure full recovery.
- **Schedule of tournaments** need to be planned by **providing adequate recovery time** for players before subsequent matches.

Practical Applications – Recovery & training



- The high variability in metabolic responses and fluid and electrolyte imbalances among players after singles matches suggests **individualized consideration and advice on recovery and fluid replacement for players.**
- High intensity interval training with work rest ratio of 0.54 for male and 0.47 for female badminton players is recommended for **training junior level players.**
- More precise and consistent knowledge is required in this area to optimize training, recovery and performance



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